ENGINEERING NEWS.

Tribune Building, New York City.
GEO. H. FROST, PROPRIETOR.

SATURDAY, JANUARY 8, 1881.

THE first constitutive meeting of the Panama Canal Company will be held on Jan. 31.

WE are informed by Mr. Walter J. Morris, the chief engineer of the New York Underground Railway, that the company will probably execute contracts so that work can be commenced, upon that portion of the road requiring tunneling, some time during the present month. All the necessary plans have been prepared.

WHEN the time of a "limited" ticket expires, the railway company can enforce payment for fare over the untraversed portion of its route from the holder of the ticket. Benny Auerbach's ticket expired at midnight of Sept. 26, and the conductor put him off at Hudson, N. Y., at 8 p. m., because he would not pay fare to New York City. The court sustained the railway company.

THE Association of County Surveyors of the State of Ohio will hold its annual meeting at Columbus, Ohio, commencing on the 10th inst. Correspondence from various parts of the State indicate a growing interest in the affairs of the Association, and render it quite certain that there will be a much larger attendance than heretofore. We hope to be able to give an early report of the proceedings of the meeting.

ON Wednesday last the obelisk reached the center of the pedestal upon which it will eventually rest. The shears upon which it will be swung to an upright position are made of heavy angle iron so braced as to resist the great weight of the monolith. They are in place, and the only work now remaining is to adjust the plates and swivels for turning, and to remove that portion of the trestle which would interfere with the operation. This work will probably be accomplished in a few days, when the great stone will be swung to its final resting-place.

THE very interesting and valuable article on the "Water Supply of Paris," which we conclude this week, was prepared by Mr. Hutton from personal examination and from statistics collated in Paris, during a recent visit to that city. The profession, we are sure, will feel indebted to Mr. Hutton for this contribution to the literature of water supply.

We will commence next week the publication of one of the most valuable papers on bridge construction that can be found in the literature of engineering. This is "*The Design generally of Iron Bridges of very Large Span for Railway Traffic.*" By Thomas Curtis Clarke, M. Inst. C. E., Past Vice-President of Amer. Soc. of C. E., and President of the Phœnixville Bridge Works. The paper was read before the Institution of Civil Engineers May 21, 1878, and was the only communication relating to the American practice of construction of iron railway bridges of long span submitted to the Institution since 1863, when Mr. Zerah Colburn read a paper on the subject. Mr. Clarke was awarded the Telford Medal, the highest prize given by the Institution, for his paper. The paper is only published in the proceedings of the Institution, and on account of the expensive character of the composition and illustration, it is not probable that it will be published very soon in this country except in ENGINEERING NEWS. It is very copiously illustrated, especially with the designs and details of the Ohio River bridge of the Cincinnati Southern Railway, and of the Kentucky River bridge of the same railway; appendices giving the particulars and dimensions of tubular and girder railway bridges; the specifications, and still more important, the series of tests for the Cincinnati Southern Railway, are published, and the paper is discussed by the most eminent engineers of Great Britain.

WE wish to say here, at the beginning of the year, that papers published from time to time in ENGINEERING NEWS, will not be reproduced during the year in book or pamphlet form. *It doesn't pay*, since the majority of the profession throughout the country read the paper very carefully every week, and would not buy the articles again; and another reason is that in order to enhance the value of ENGINEERING NEWS in the future the above policy is adopted.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

We will begin on March 1 the publication in ENGINEERING NEWS of a work entitled "The History and Statistics of American Water-Works," by J. James R. Croes, Mem. Am. Soc. C. E. This publication will be continued weekly, and it is expected that it will be about a year in publication and occupy 100 pages of the paper. It is intended to comprise an historical sketch of the inception and progress of all works of water supply in the United States and Canada, with a description of the peculiar features of each, and such data as can be obtained respecting both the success and the failure of various structures, and modes of construction and operation.

In addition to the historical sketches, special chapters will be devoted to the consideration of the actual and comparative cost of the introduction and operation of the several systems of water supply in use, and full tabular statements will be presented of the work and cost of pumping engines, of the extent, cost and durability of the different kinds of pipes, hydrants, meters and other appliances. Tables of the water rates, and the principles on which they are based, in large and small towns will be given.

A large proportion of the blunders made in the first organization of water-works arise from ignorance of the parties interested in them as to what has been tried in other places, and what has proved successful and what failed. The laws of the various states regarding the organization of water-works by municipalities and private corporations are very diverse, and a summary of their provisions will be given, which will be of great assistance to all who propose new organizations, and a comparison of them will, it is hoped, lead to such modifications as will result in a certain uniformity on a good basis.

The collection of statistical information was begun by Mr. Croes for the exhibit of the American Society of Civil Engineers, at the Philadelphia International Exhibition of 1876. The material then collected, and much which has since been acquired, will be employed in the preparation of this work, and it is expected that this announcement and the beginning of the actual publication will bring in a large amount of desired information which it has been difficult to obtain heretofore.

THE DEMAND FOR ENGINEERING WORKS.

The capitalists of this country and of Europe are looking about eagerly for chances of good industrial undertakings. The economic change which has taken place in Europe, owing to American competition and other causes, is no slight one. It may be said, in a word, that the liberated capital of Europe must in future be employed to a great extent, in doing, in new countries, what it has already accomplished in the old. Railroad building, the opening and improvement of ports, the widening and regulation of rivers, canal cutting, and all the material evidences of civilization have yet to be accomplished in the largest and fairest portions of the globe. The engineer is similar in the present time to the backwoodsman of the past—he is the pioneer of civilization. The resources of the United States are developing so rapidly that the engineering profession is in constant requisition. At the same time it must be remembered that the attention of foreign engineers is directed to this country as well as to others. The English engineer and contractor is everywhere. While, therefore, the great field for the American engineer remains the United States, yet there is no reason why he and the contractor should allow the profitable works which will now, more than ever, be in progress in the South American countries, etc., to fall into the hands of European competitors. Such a neglect would have a double effect—foreign engineers and contractors would have, in common phrase, "things their own way," and the home market would soon be over-stocked.

The Trans-Mississippi region, and especially the southwestern portions, will obtain such an increase of population in the next decade as will fully insure the construction of subsidiary lines. Texas has become the tenth State, in point of population, and is an object of special attention on the part of English capitalists, as well as of settlers in the neighboring States. The vast regions which will be opened up to cultivation must be supplied with veins as well as main arteries. The argument, which has been sometimes brought up, that the ratio of the mileage of railroad to that of population is increasing, cannot hold good for any length of time. The natural increase of population, and the immigration, which promises to be in even greater volume than ever before, will soon bring industrial undertakings into now unknown regions. The annual emigration from Europe alone is equal to the population of an average State. But, with this increased population and traffic there will arise, as usual, a demand for better laid lines, and more commodious stations—the latter deficiency being very marked as compared with those of European lines.

The construction of water-works and sewers, has become one of the great specialties of English engineers, who have monopolized this branch in almost every country of Europe and South America. The sanitary condition of the Southern countries are such that these works are considered as urgent, and new works are being contemplated everywhere.

But, it is the fact that American contractors and engineers who are engaged in large works in foreign countries can do much toward giving American engineering a prestige, that we consider as most important. The rest of the world is not standing still. English engineers are pestering Turkish officials for concessions for railroads through Asia Minor. Bagdad, at which port a vessel was always about to leave, will soon be a terminus. The Nile cataracts have necessitated the construction of a railroad to Gondokoro. The Italian and French establishments on the western shores of the Red Sea will soon develop railroad enterprises in

the fertile regions of Central Eastern Africa. The feature which will be most apparent in the near future is this extremely rapid civilization of new countries. The lands traversed by Cameron, Pinto and others will give an enormous scope for engineering work, for without the rail nothing can be done, while it is the only means of stopping the present system of slave carriers. The Belgian, French, English, Italian and German governments have all expeditions at present in different parts of Africa, and something good must result from them in the near future to the engineer.

THE HUDSON RIVER TUNNEL.

After nearly six months of continuous work, carried forward under the most discouraging circumstances, and seemingly in the face of insurmountable obstacles, the tunnel has been again opened and the work resumed where interrupted by the accident. We visited the tunnel on Wednesday and Thursday of last week for the purpose of examining the interior operations.

A wall has been built on the side of the caisson next to the shaft—false work being left where the interior of the tunnels will pass. The same has been done at the opposite, or river, side, and the masonry extended to the roof. After the invert to sustain the arches had been completed and the center pier built to about half its intended height, an arch of heavy brick-work was thrown over—just inside the arch of the caisson, and resting on the side walls of the north and south tunnels. The completion of this undertaking gave a large working chamber, built entirely of solid masonry, entered by two air-locks—vertical and horizontal—and from which the tunnels opened. This chamber is self-supporting in every part, and is absolutely free from the caisson, in regard to which Mr. Andersen said that they "might come and steal it away for all I care: I am safe enough without it."

The tops of the two tunnels are several feet below the openings of the air-locks, so that in case of a blow-out at either of the headings there would be a large chamber of air and an uninterrupted passage to either lock.

It will be remembered that the connections between the caisson and the tunnels and the old air-lock were made by cutting openings through the side, of about the size of a plate, and then telescoping the plates on to the outside of the tunnel. These were put in one at a time until the set was finished, then they were bolted to each other and to the wall of the caisson. After this had been done both openings were bulk-headed, until the connecting brick-work could be completed.

The north tunnel had been finished for about three hundred feet, and the most rigid examination could not detect the least indication of a break caused by the flood. During the past two weeks the entire surface of this tunnel has been washed with cement to more effectually confine the air.

As mentioned in a previous article, the ebb and flow of the tide in the shaft was through the south tunnel. This necessitated resorting to artificial means for increasing the compactness of the silt behind the bulk-head. This was accomplished by forcing silt through pipes inserted in the bulk-head until a consistency was obtained sufficient to resist the air pressure. As soon as possible the plates for a pilot tunnel were put in. These plates are four feet long, twenty-two inches wide and curved so that ten rings are required to form the circle. In this tunnel was loosely fitted a piston designed to force the silt into any weak part of the heading. The piston was thrust forward by two square timbers which at first reached across the caisson to the opposite wall, where hydraulic jacks constituted the motive power. After the pilot had been advanced some distance the jacks were braced against the interior rings.

The pilot is carried forward in precisely the same manner as the tunnel had been before the accident. The silt is removed from the top, the plate inserted and bolted to the one already in position; the work is carried down each side and finished at the bottom. The silt at the heading retains the air pressure, and, as the exposed portion is only a little over six feet in diameter, it can be easily watched and the first indication of a leak quickly noticed and the remedy applied. At every longitudinal joint, plates one-half inch thick, and wide enough to make a flange upon the outside of about six inches in width, are inserted. This flange is designed to partially prevent the silt, when forced by the piston through the interior, from making its way down the exterior. It also adds materially to the strength of the pilot; the plates are of three-eighths iron, flanged and bolted with the inset between; and, as the joints are broken, the whole

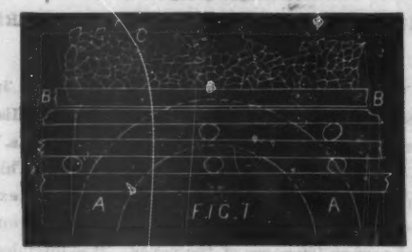


FIG. 1

may be considered as forming a ring one and one-quarter inches thick at the strongest part and about nine inches wide.

The work of building the tunnel may be briefly described as follows: The pilot tunnel is carried along about ten or fifteen feet in advance of the large one. In constructing the main tunnel an excavation is first made for the top plate, which is put in position, bolted to the one already up and upheld by braces resting on the pilot. One side is now started, and the plates put in about half way around, when the other side is commenced. The sides are then extended until they meet under the pilot, the entire

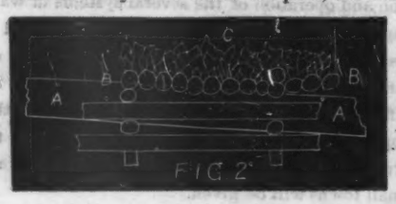


FIG. 2

ring being braced from the pilot, and the whole presenting the appearance of an immense wheel, the pilot being the hub, the braces the spokes, and the plates the tire. With the air pressure kept at its maximum there is little or no strain upon the braces; nevertheless, they are put in so as to be able to resist the weight should the air be entirely removed.

After a few rings of plates have been placed, the brick-work is commenced at the bottom and carried over, the braces remaining until the whole has set. The use of a pilot tunnel will not only increase the safety of the men in a great degree, but will expedite the work and permit the main tunnels to be built on the true grade—a thing that was impossible in the old method, owing to the unequal settling.

On the 30th ult. the brick-work of the south tunnel had been finished for a distance of thirty feet from the east side of the caisson, the plates extending about twenty feet further. Some twenty-five feet of this had been built under the crib-work of the bulk-head. This presented serious difficulties, as all the water that came in found a passage through the interstices between the logs. To keep the grade of the tunnel, it was necessary to cut off four or five of these layers nearest the shore, and to fill the openings so that the air could be confined. To a certain extent the pilot tunnel with its piston did this, but it was impossible to obtain power enough to compactly fill all the holes. A small pipe was placed in each opening separately and the silt forced in, when it was allowed to settle for some time. A frequent repetition of this operation solved the problem, and the pilot was sent through the timbers. The same crib-work retarded the north tunnel, but, as the silt had not been disturbed for years, it was not of a serious character.

Fig. 1 shows a cross-section of the bulk-head, and Fig. 2 a longitudinal view of the same; *C* being the loose stone filling through which the water found a passage, *B B* being the flooring resting on the crib-work, and *A A* the tunnel. Owing to unequal settling that portion of the bulk-head nearest the shore was lower than the rest, so that the crib-work was slightly arched, thus making much more cutting at that end of the work in order to maintain the true line of the tunnel. At a distance of twenty-five feet from the end of the bulk-head, the top plates of the tunnel cleared the timbers.

We noticed upon leaving the tunnel, after a visit of about two hours, that the secretions of the nasal organs were covered with a black, impalpable powder, probably carbon from the two electric lights. As yet this has caused no ill effects upon the men, and although its appearance has been noticed, especially in expectorations, no difficulty is anticipated.

CONTRACTS AND CONTRACTORS.

American contractors may sometimes consider themselves as badly used by municipal bodies, whenever specifications are strictly enforced. But their troubles are, in general, light as compared with those of their Bavarian *confrères*. The Union of German Engineers sent a memorial sometime ago to the different Ministers of Public Works in the Empire, desiring that contractors for public works should not be subject to any higher penalties than would be legal in the case of private individuals. The Prussian minister acceded to this proposition, at least to some extent. But not so the Bavarian official, who has actually increased the stringency of the regulations. If work or wares are not satisfactory in every respect, the deficiency is to be made good at once and the contractor has not only to pay high prices, but is mulcted in ten per cent. besides. But the most disagreeable feature of all is the obligation under which every contractor is placed of subscribing one-tenth of one per cent. to a fund for the relief of ex-railroad employés.

ENGINEERING WORKS IN CENTRAL AND SOUTH AMERICA.

The Brazilian Minister of Agriculture has issued instructions for the examination of the bar at the entrance to the harbor of Victoria, Espirito Santo, on the return of Col. Roberts from the North.

Tenders are solicited for the extension of the Dom Pedro II. Railroad.

The Brazilian Government invite tenders for the construction of the North line of Rio Grande, from Santa Maria to Uruguayana. The work must be finished in a very short time.

The *Revista de Engenharia* criticises severely an article in the London *Times*, which reflected on the professional standing of Brazilian engineers. The disaster at the Pedregulho Works is sufficient for the correspondent to fall foul of the whole *corps* and characterize them as inexperienced and presumptuous. The Tay Bridge and our own Hudson Tunnel are cited as instances of mistakes by engineers of other nationalities.

Col. Roberts has been ordered by the Brazilian Minister of Agriculture to examine the ports of Recife Ceara and San Luiz, and to ascertain whether it be possible to carry out the improve

ments for less than the estimate of Sir John Hawkshaw.

THE FUTURE OF STEEL AND IRON.

Great attention is being given in England and Germany to the future condition of the iron market. The annual production of iron is now estimated at 13,673,000 tons—that of Bessemer steel at 1,885,000 tons. The recent progress in metallurgy bids fair to vastly increase the manufacture of steel. The demand, however, will surely be equal to the supply, for the cheaper prices on the one hand, and the new uses of iron and steel on the other, will give an extraordinary stimulus to the demand. It is thought that dephosphorized steel will be produced in Europe at about $20 per ton. Whether the dephosphorized steel will meet all the requirements of the engineer has yet to be seen. That steel will now be exclusively employed for rails is certain; that steel sleepers will soon be found on every well-laid road, is equally so. Steel sleepers are largely manufactured in Germany, and at present 70,000 tons of those sleepers have been laid down on Continental roads. That iron and steel will enter largely into the construction of many works which have hitherto been of wood admits of no doubt. The supply of wood is becoming scarce, and will, before many years, only suffice for purposes in which it is indispensable. Wood pavements will be replaced by iron ones; houses, as well as ships, will be of that metal, and it is not at all unlikely that iron railroad cars will soon be introduced everywhere.

JAPANESE SANITATION.

The rate of mortality in Tokio, a city of 750,000, is only 21 per thousand, somewhat about the normal rate of London, and only surpassed by the healthiest surburban districts of Europe and the United States. There are several peculiarities of the condition of Japanese cities to explain this apparent contradiction. Bad sewers are worse than none at all. There are no sewers in Japanese cities and the gases have no place for formation. Large open gutters run along the streets and into these the garbage is cast. But although decomposition sets in rapidly in warm weather, the heavy rains which follow regularly carry off this matter to the rivers and canals. Except in Tokio, wells are generally used, and in any case the Japanese, like the Chinese, have an abhorrence of cold water, and always use it in the form of tea. Wooden pipes are used in the principal streets of the cities, but they are supplied from wells. Other reasons for the healthfulness of the Japanese must be sought in their temperate life, the absence of the feverish excitement of highly civilized countries and in other causes.

The comparative salubrity of countries is not altogether a matter of climate. Batavia, which was regarded as the cemetery of Europeans some years ago, is now almost a healthy city, and its beautiful villas, stretching along miles of shaded roads, render it a town distributed along a park. The sanitary engineers effected this transformation. The frightful mortality in Atcheen, and other parts of Java, shows that the general deadly character of the climate has not changed. How much of the unhealthfulness of tropical countries must be attributed to decaying vegetation has not yet been ascertained, but the fever-producing districts of Africa and America are always remarkable for masses of dead wood and stagnant water, and it is in the removal of these causes that improvement must be looked for. The density of population in Oriental and in our own cities is altogether widely different, and however great may have been our progress in sanitary science, sanitary works have not been carried on in an equal proportion to this increase of population.

PERSONAL.

Charles Hamilton has been appointed General Superintendent of the Cairo & St. Louis Railroad, vice L. M. Johnson, resigned.

General Charles B. Stuart, civil engineer, died in Cleveland this week. He was the author of several works on civil and military engineering subjects.

Mr. L. M. Johnson, late General Manager of the Cairo & St. Louis Railroad Company, has been appointed Assistant to the President of the Pullman Palace-Car Company.

J. B. Stearns, the English electrician, has arrived in this country on his way to Mexico, where he will lay an electric cable from the mouth of the Rio Grande to Vera Cruz.

Wm. Paul Gerhard, Sanitary Engineer, of St. Louis, Mo., has accepted a position as Assistant Engineer under Col. Geo. E. Waring, Newport, R. I., at which latter city his address now is.

William A. Lighthall, the oldest marine engineer in the country, died at Brooklyn on the 4th, aged seventy-six. He was born at Albany, and was engineer of the first Hudson River steamboat, the Clermont.

Mahone, the new senator from Virginia, was a poor Irish boy educated on a free scholarship at the military institute where Stonewall Jackson taught, and began his career by carrying a surveyor's chain on a railroad.

C. N. Danenhower, C. E., formerly City Engineer of Cincinnati, O., is at present Engineer-in-Charge of the Sewerage of Washington, D. C., under the direction of Lieut. R. L. Hoxie, U. S. A. His address is Morrison Building, Washington, D. C.

An architect who built a new city hall for a western town made a botch of it and fled to Canada, "to remain until the affair should blow over," as he left word with his friends. Next day a high wind struck the town and his friends telegraphed him: "Come back. The whole shebang was blown over last night."

Tiffin, Ohio, does not appreciate the improving times. With a population of 10,000 it has been paying its City Engineer, J. L. Folz, who for ten years has satisfactorily filled the office, the yearly stipend of eight hundred dollars; this year it is cut down to six hundred, which is less than Mr. Folz will accept. He has resigned but now does the city work by the day.

Capt. Eads was interviewed by the editor of *El Noticioso*, in the City of Mexico, the other day. To the question, "And once the concession you seek from the Mexican Congress is given, will the necessary capital be immediately forthcoming?" the modest captain replied: "Without a moment's loss of time! My large experience gives many great capitalists full confidence in me, and I can furnish any security required."

A delegation consisting of Ald. R. Y. Force, Chairman of Public Grounds and Public Buildings; Ald. Robert Bandhauer, Chairman of the Fire Department, and H. C. Lowrie, City Engineer, of Denver, has been appointed by the Denver City Government to come East and visit the various cities and examine the workings of their fire, water, and sewerage departments. The City of Denver is now constructing a sewerage system, and has under contract at this time $170,000 worth of this class of work. It also proposes to build water-works and additional engine-houses. The delegation was in Chicago on the 4th, and from thence would go to Fort Wayne, Pittsburgh, Philadelphia and New York.

Hector Martin Lefeul, the noted French architect, a Commander of the Legion of Honor, died in Paris, this week, aged 70 years, having been born in 1810. He was a pupil of Huyot and l'Ecole Des Beaux Arts. He was architect of the chateau of Meudon, also that of Fontainbleu, and in 1854 replaced Visconti at the Louvre. In 1851 he was engaged upon the Exposition Buildings in Paris, and was soon after appointed chief architect of the Louvre and National Palaces. He also made reputation by his embellishment of the Tuilleries. In 1867 he was a member of the Imperial Commission for the Exposition, and in 1873 was made a member of the Superior Commission of International Expositions. He was one of the Fine Art Jury at the Vienna Exposition, and was President of the Institute in 1875.

AMERICAN MINES.

The New York *Tribune* published on Monday morning last a summary of authentic information concerning the mining industry in the United States, in the form of a table, revised and enlarged from a previous issue. It presents in a condensed shape a mass of important facts connected with the companies engaged in opening or working mines of the precious metals, such as their names, offices, locations, capital stock, dividends, extent of claims, character and value per ton of ores, width and depth of veins, buildings and improvements, value of ores in sight, etc. This information can nowhere else be obtained in a single publication. To gather, collate and verify it has been a matter of considerable labor and expense. For the greater convenience of readers, the present issue will be republished in pamphlet form in a few days, at a cost, we suppose, of ten cents per copy.

The *Tribune* remarks editorially:

"It will be seen from the statistics we present that the past year has not been a favorable one for speculative mining operations. Stocks have, as a rule, gone down, and distrust has taken the place of buoyant and exaggerated confidence. At the same time the business, regarded as a productive industry, has more than held its own. The number of dividend-paying companies has nearly doubled, the total yield of ore is remarkably steady and an exceedingly good percentage has been earned on the capital actually invested in land, machinery and working expenses, while the industry is constantly expanding, conquering almost every month new fields, and drawing to itself additional forces in the way of capital and men.

"Mining for silver and gold has grown to be one of our most important sources of national wealth. There is no more reason to fear its decline than to apprehend a sudden collapse of iron mining. Fortunes are no longer made, it is true, by the rapid rise of stocks or by feverish speculative movements on the Exchange, but the industry is on a more solid basis, and is more inviting to legitimate investment than ever."

THE WATER SUPPLY OF PARIS.

Written for Engineering News.

BY WM. R. HUTTON, C.E., BALTIMORE, MD.

(*Concluded from page* 6.)

THE RESERVOIR OF MONTROUGE,

which receives the water of the Vanne, is a masonry structure of two stories, the ground arches which form the roof of the lower basin being the floor of the upper story, which again is covered with lighter arches carrying about two feet of earth. It occupies a rectangular area 942′ × 443′ (287m. × 135m.). It rests upon a coarse limestone, in which about 65′ below the surface have been quarried the subterranean galleries now known as the "catacombs." The consolidation of these galleries under the reservoir was an indispensable precaution, and one of considerable cost.

The lower story will be filled to the depth of 18′ (5.50m.) storing 7,069,000 cu. ft. (200,000 cu. m.) of water, the upper story to a depth of 11.64′ (3.55 m.) will contain 4,240,000 cu. ft. (120,000 cu. m.), with its surface at 262.5′ (80m.) above the sea.

Each story is divided into two parts by a wall parallel to the short side.

Its general construction is similar to that of the

reservoirs of Menilmontant and Belleville, to be described later.

The cost of this reservoir was $1,356,000, of which about $140,000 was expended for works in the old catacombs under the site.

SPECIAL WORKS.

The aqueduct bridge of Arcueil rises to 125′ (38 m.) above the bottom of the valley of La Bievre, a small stream which flows through Paris to the Seine. It is built upon the old aqueduct of Maria de Medici, with 77 arches of 33′ to 36′ span (10 m. to 11 m.), built entirely of rough rubble masonry, in Portland cement; and its total length is 3,249′, or 990 meters.

The crossing of the Yonne River is composed of 162 arches, of spans varying from 20′ to 131′ in length.

The pumping stations, three in number, are for the purpose of raising the water of the low springs to the level of the aqueduct. They are operated by the water of the Vanne, and occupy the sites of three miles. One of them has three Sagebien water-wheels and three pumps. The others have each two water-wheels of the same kind and two pumps. Their estimated cost, including buildings, is $154,000.

But the water of the Vanne could not reach the higher portions of the city. For these an additional supply was needed, and at a greater elevation. The quantity was fixed at 1,413,870 cu. ft. (40,000 cu. m.) for the domestic supply, and for the public service at 1,520,000 cu. ft. (43,000 cu. m.) per day. The former is furnished in spring water from the Dhuys, the latter by pumping from the Marne.

AQUEDUCT OF THE DHUYS.

The springs of the Dhuys, situated about 80 miles from Paris, in the department of Aisne, come from the green marls of Montmartre, which underlie the entire surface of la Brie. The springs discharge into a stream of the same name, which receives the little river Verdon. They together fall into the Surmelin, which empties into the Marne a few miles below. As the Dhuys furnished but 24,000 cu. m. (848,300 cu. ft.), the rest of the supply was to be obtained from springs on the Verdon and Surmelin.

The hydrotimetric gauge of the water was 23 degrees. Upon analysis it was found to contain only carbonate of lime; the quantities of sulphates, chlorides and alkaline salts were insufficient.

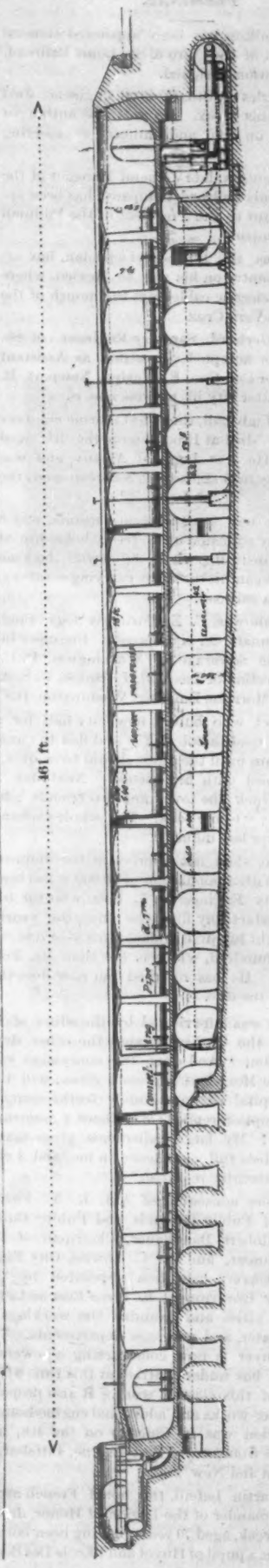
From the springs the aqueduct extends along the slopes of the left bank of the Dhuys, the Surmelin and the Marne to Dampmart, near Lagny, where it crosses the river and keeps the right bank to the summit of the gypsum hills, which reach from Lagny to Paris.

For two-thirds of its length the aqueduct lies in the white marly limestones belonging to the lacustrian formations, and in sand. These soils are generally very solid. The other third is in ground of the very worst quality, in the friable white marls of the gypsum, or the unstable green marls of Montmartre.

The works were commenced in June, 1863, and pushed with so much vigor that the water was introduced in August, 1865.

For a distance of about 1¼ miles from the springs the aqueduct is formed of two circular masonry conduits, 3.28′ (1. m.) in diameter, connected at various points. The section of the main aqueduct is ovoid 5.77′ (1.76 m.) in height, 4.59′ (1.40 m.) wide. The masonry is 10″ (0.25 m.) thick, including a coat of mortar on the inside. The masonry of the haunches is a little thicker. The water level is one foot below the crown. Manholes are spaced 500 m. (1,640′) along the conduit. A short length near the reservoir of Menilmontant is covered with a gallery 11.8′ (3.6 m.) wide and and 8.2′ (2.5 m.) high.

All the conduit masonry is of rough rubble in Roman cement.



AQUEDUCT OF THE DHUYS—RESERVOIR OF MENILMONTANT—TRANSVERSE SECTION.

The siphons are of cast-iron 3.28′ (1 m.) in diameter, with socket joints. Each siphon is furnished with a waste valve at its lowest point, and an air cock on the high points; and an overflow waste is built at the upstream end of every siphon and tunnel.

	Feet.	Meters.
The elevation of the springs above the sea is....	420	128
The water surface of the reservoir of Menilmontant.....	354.4	108
The total fall of the aqueduct is, therefore.....	65.6	20
The slope of the masonry aqueduct is.....		0.0001

The head on the siphons is 0.00055 (× their length).

	Miles.	Meters.
The length of conduit in open cutting is....	62.66	100,822
" " " tunnel.....	8.03	12,928
" " " siphons.....	10.65	17,130
Total length	81.34	130,880

The cost of the work was something less than the estimate of $3,600,000.

During the very dry season of 1858, the supply of 24,000 cu. m. from the Dhuys was considered a minimum, but in 1865 it fell to 20,000 cu. m., and in 1874 to 17,000 cu. m. (600,900 cu. ft.). In 1879 it is officially stated that the remaining springs of the Verdon and Surmelin do not furnish a quantity sufficient to compensate for the cost of its introduction.

The reservoir of Menilmontant is built upon the high ground, on the eastern margin of the city, just inside the fortifications, and overlooking the cemetery of Père la Chaise.

It was difficult to find a proper site. All the high grounds on the right bank of the Seine contain gypsum, which has been largely mined, and they were consequently wanting in solidity.

When the present site was discovered, which had not been worked, the soil was found to be of the worst possible character—the soft, green marl of Montmartre, and it became necessary to go down to solid ground, a depth of from 20 to 23 feet. It was then determined to remove the soft clay between the piers of the foundation, and establish a reservoir for the public service under that for the spring water of Dhuys.

The lower reservoir is a rectangle of about 305′×328′ (93 m.×100 m.) and contains 1,000,000 cu. ft. (28,500 cu. m.), the overflow pipe being placed at 328.18′ (100 m.) above mean tide.

The foundation piers, spaced 19.7′ (6 m.) between centers, are sunk 3.28′ (1 m.) into the solid ground below the marl, and vary in height from 7.4′ to 20′ (2.25 m. to 6.10 m.). They are 6.5′ square at the bottom, battering to 4.92′ at 2′ above the base, and to 4.6′ at the springing line. They support semi-circular groined arches of 15.1′ (4.60 m.) span, 13.78″ thick at the crown. They are leveled up on top and form the floor of the upper reservoir. The exterior walls are 4.59′ (1.40 m.) thick at top with a batter of $\frac{1}{10}$ on the inside, and connect with the floor by a curve of 6.56′ (2 m.) radius. The floor, of concrete, is 11.81″ (0.30 m.) thick.

The upper reservoir is in plan a semi-circle of 616′ diameter, increased by a rectangle formed upon the diameter by a depth of 137.8′ (42 m.) It contains 3,534,700 cu. ft. (100,000 cu. m.) of water from the Dhuys and the spring of St. Maur, at an elevation of 354.43′ (108 m.) above mean tide. (The reference for Paris is the zero of the gauge of the Bridge of La Tournelle, which is 86.147′ (26.25 m.) above mean tide.) The piers are 1.97′ square (0.60 m.), placed directly over those of the foundation, 16.74′ (5.10 m.) high, and they support groined arches of 17.71′ (5.40 m.) span, and about 2 ft. rise. The arches are composed of two courses of tiles laid flatwise and breaking joints, making a thickness of 3½″, built with equal parts of Vassy cement and sifted sand, with a plastering ⅜ of an inch thick. The spandrils are filled with a cheap concrete, composed of 10 parts of sand to one of lime, and over this is placed 4″ of gravel and 16″ of earth. The entire surface is then sodded.

It is considered important to have smooth surfaces, easily cleaned. All the masonry is, therefore, covered with a coat of cement mortar, and

all re-entering angles are rounded to a radius of about one foot.

The exterior walls are surrounded by an earthen embankment, sodded.

In view of the very serious consequences of any failure of the works when in use, and of the care necessary in its construction, the work was done under a special contract, without competition.

Reservoir of Belleville.—A reservoir was designed to occupy the vacant space in the cemetery of Belleville, the highest ground in Paris on the right bank of the Seine. It was intended to be two stories in height, with two compartments in each story. Only one-half of it has been built. The upper story contains 6,239 cu. m. (220,528 cu. ft.) of water of the Dhuys, at an elevation of 134.40 m. (441′); the lower one is supplied with Marne water, and contains 11,765 cu. m. (415,800 cu. ft.). Both are supplied from the upper and lower reservoirs of Menilmontant, by two compound (Woolf) engines of 25 horse-power each, driving a double system of very beautiful Girard pumps. The force main 11.9″ (0.30 m.) in diameter, and 3,330′ (997 m.) long.

Reservoir of Menilmontant :	
Cost of the works	$730,000
Lands	76,000
Accessories	14,000
	$820,000

Cost per cubic meter of useful capacity, 32 francs; per cubic foot, 18.8 cents.

Reservoir of Belleville :	
Works	$88,800
House for keeper	4,000
	$92,800

Cost per cubic meter of useful capacity, 26 francs; per cubic foot, 14.6 cents.

The position of the Belleville reservoir is even more threatening than that of Menilmontant. It is entirely above ground, and stands upon a soil very easily washed. It was constructed with the greatest care, under a contract, without competition.

Spring of St. Maur.—Near the pumping station of St. Maur which supplies water from the river Marne to the lower reservoir of Menilmontant, for public purposes, there exists a fine spring which furnishes about 176,500 cu. ft. (5,000 cu. m.) per day. This, by a special water-wheel and pump, is elevated to the upper reservoir of Menilmontant, and distributed with the water of the Dhuys.

The cascades and the watering of the Parc des Buttes Chaumont required a larger quantity of water than could be spared from the reservoir of Menilmontant. They were, therefore, supplied with the water of the Ourcq, pumped from the basin of La Villette into a special reservoir.

The pumps are driven by a compound (Woolf) beam-engine of 55 horse-power, with two water-tube boilers.

Cost of engine and pumps with one boiler		$19,062.40
" " second boiler		4,862.80
" " buildings, etc		21,000.00
" " accessories		12,093 80
5,218 ft. (1,590m.) of force main 15.75″ (0.40m.) in diameter		8,396.00
		$65,979.60

The reservoir of the Buttes Chaumont is formed of 2 uncovered compartments, containing 310,000′′ (8,800 cu. m.) at a height of 318″ (90.90 m.).

Cost of construction	$22,029.40	
" " plumbing, pipes, valves, etc	571.00	$22,600.00

The Artesian well of Grenelle forms a jet 108.5′ high (33.70 m.) from the ground. Its depth is 1,674′ (510 m.) below sea level, and from the surface of the ground 1,794 (547 m.), and supplies 21,208 cu. ft. (600 cu. m.).

The well of Passy furnishes 282,774 cu ft. (8,000 cu. m.) per day.

The two new ones, commenced to complete the supply of Paris, were designed to be 1.20 m. (about 4′) in diameter, but this has since been increased, in order to diminish the velocity and thereby retain the clearness of the water.

Public Supplies.—Pumping Station of St. Maur.—About 5 miles from Paris the river Marne makes a great detour, returning upon itself, so as to leave a very narrow isthmus, upon which stand the villages of Joinville-le-pont and St. Maur. The river is unnavigable, by reason of the rapid current and great slope around the bend, and the isthmus has been pierced by a tunnel for the canal, which connects the navigation of the Marne with that of the Seine at Charenton. It also formerly supplied the mills around the bend.

The total fall from the dam at Joinville averages about 13.5′ (4.10 m.). In 1863 this water power operated 52 pairs of burrs, a cotton factory, a woolen factory, a zinc mill, a file factory, and a saw-mill.

In 1864 the property was purchased by the city of Paris, which, to avoid injury to the navigation by an increased velocity through the tunnel, built a second tunnel, and replaced the mills by a pumping stations, containing seven water-wheels and two steam engines, to wit :

One Fourneyron turbine of 100 horse-power raises about 424,000 cu. ft. (12,000 cu. m.) of water to the lake of Gravelle, to supply the lakes and streams of the Bois de Vincennes. Two other similar turbines and three Girard turbine wheels elevate from 1,166,000 cu. ft. to 919,000 cu. ft. (26,000 cu. m. to 33,000 cu. m.) to the lower reservoir of Menilmontant at 328′ (100 m.) above tide.

A fourth Girard turbine wheel raises into the upper story of the same reservoir, at 108 m. (354.4′) above tide, 5,000 cu. m. (176,733 cu. ft.) of water from the spring of St. Maur.*

These seven machines, of a nominal power of 780 horses, can elevate in 24 hours, when water is abundant, 50,000 cu. m. (1,767,330 cu. ft.), and in ordinary times 43,000 cu. m. (1,519,900 cu. ft.) of water. The supply sometimes falls to 38,500 cu. m. (1,360,447 cu. ft.) per day, and when this occurs it becomes necessary to suspend the washing of the gutters in the high parts of the city. The scantiness of the supply is caused, not only by the extraordinary droughts which have occurred since 1857, but in great part by the drawing down the Marne for repairs, and refilling the pools. A commission of engineers, however, has decided that it was not necessary to draw down the pools, and this system has been abolished.

Two steam engines have been erected for use in the times of scarcity. The first is a Corliss engine as modified by M. Farcot, the builder. Its power, of 150 horses, can raise 459,500 cu. ft. (13,000 cu. m.) per day to 328′. In 1874 its consumption of coal was 2.48 pounds (1.125 kilog.) per hour per horse-power, measured in water raised.

The pumps are horizontal direct-acting plunger pumps, two in number, placed end to end.

The second engine, erected in 1876, is of similar, but improved construction, and is said to have consumed but 2.03 pounds of coal per horse-power per hour in water raised, and 1.54 pounds per indicated horse-power.

The total cost of the establishment was		$1,597,900
The annual working expenses average	19,500	
Add interest on cost at 5 per cent	79,895	
Annual cost	99,395	

The average quantity of water pumped per year being 14,079,381 cu. m., the cost per cubic meter is 0.706 cents; per cubic foot, 0.02 cents.

This does not include the steam engine.

The first cost of first engine	$36,300	
Buildings and accessories	39,000	
		$75,300
And for the works entire		1,708,500
The cost of the second engine, estimated	35,000	
" " buildings and accessories	18,000	
	$53,000	

These expenses will not sensibly increase the cost per cubic foot of the water, as the two machines will largely increase the quantity raised.

A simple calculation will show that the cost of one meter cube of water raised one foot high, is .01038 cents (=0.00009c. per cu. ft., one foot high). If it is considered that the water raised by the best steam engines the city owns, those of the pumping station of the quay of Austerlitz, cost .0156c., it will be seen that the cost of the establishment will be repaid by the saving in cost of operation.

The pumping works of Trilbardon and Isle des Meldeuses, were constructed to elevate to the Canal d'Ourcq a supply of water from the Marne, which is indispensable to it in dry seasons. They can each supply 0.5 m. (17.67 cu. ft.) per second or 1,527,000 cu. ft. per day, during low water.

The principal water-wheel at Trilbardon is a Sagebien wheel, 36′ (11.04 m.) in diameter, 19.50′ (5.96 m.) width of crown. The fall varies from 1.30′ (0.40 m.) to 4′ (1.20 m.) It can pass 5.5 cu. ft. to 13 cu. ft per foot of width (0.5 m. to 1.10 m. per meter) per second, and makes one and a half revolutions per second. Its work in water raised is 70 per cent. of the theoretic power of the fall. Mr. Belgrand remarks that it is certainly the best motor owned by the city.

The pumping station of the quay of Austerlitz contains two engines of 120 horse-power each, and raises Seine water to the reservoirs of Charonne and Gentilly. The engines are by Farcot & Sons, compound, two cylinder, with variable cut-off. Steam is furnished by four tubulous boilers on Farcot's system. The force mains are 1.64′ (0.54 m.) in diameter, one to each reservoir.

The cost of the entire work, including mains, has been $340,000, and they raise 190,000,000 cu. ft. (5,390,000 cu. m.) of water, at a cost of .764 cent per meter cube raised 1 m. high, equal to 0.000135 cent per cubic foot raised 1 ft. high.

The engines of Chaillot on the quay "de Billy" supply 19,000 cu. m. to the reservoir of Passy.

The two engines of Maison d'Alfort, at the mouth of the Marne raise 5,000 cu. m. to the reservoir of Charonne.

One 40 horse-power engine at Port-a-l'Anglais can elevate 9,000 cu. m. to the reservoir of Gentilly.

A large pumping station similar to that of St. Maur was designed to be erected at Port-a-l'Anglais, to be worked by the water power of the dam, during the summer, for the purpose of supplying to the reservoirs of Passy, Seine water from above the city instead of that which is now pumped below the city.

It might be supposed that since the construction of the collecting sewers, discharging into the Seine so far below the city, that Seine water within the city limits would be sufficiently pure for the public service, but an analysis given in the reports for 1879 indicates that it contains eight times the quantity of impurities that is found in water taken above the city.

As will have been understood from the separation of the supplies, Paris has a double system of distributing pipes, one for spring water for domestic uses, the other for the public service—for monumental fountains, for washing streets and sewers and for extinguishing fires.

The total length of pipe of all sizes up to 51″ was, in 1874, 851.55 miles, of cast-iron, sheet-iron coated with bitumen, and lead.

Quantity of water used in 1878 :

	Cu. ft.		
For streets	3,840,000		
Promenades and woods	1,263,700		
Fountains	1,420,600		
Public buildings, hospitals, etc.	1,070,000		
Public hydrants	293,200		
Sundry	109,000	Cu. ft.	
		8,056,500	60,423,900 gals.
In private houses, paid for	3,193,000		
		3,193,000	23,947,000 "
Total		11,249,000	or 84,370,900 w. gals.

Or a daily consumption of 42.18 wine gallons per capita of population, of which 30.21 gallons was for public service and 11.97 gallons for domestic

*The supply from St. Maur was not interrupted during the siege of Paris, which was an immense service to the city. M. Lecour, the director, failed to obtain the decoration of the Legion of Honor, solely because the services rendered were not considered acts of war.

use; but to this we must add that supplied by the public hydrants, which will increase the quantity for domestic uses to 13 gallons per capita. Of about 70,000 houses in Paris, about 40,000 are supplied with water.

The new works were constructed under the general design and direction of the late M. Belgrand, Inspector General of "Ponts et Chaussées," by M. Buffet, Ch. Engr., and MM. Humboldt, Lesguiller and Huet.

Pipes.—The total length to Dec. 31, 1874;

	Meters.
Under 0.10 m.	206,002
Of 0.10 m.	622,864
From 0.10—0.19	155,734
.20 m.	63,083
0.20 to 0.25	52,169
.30	51,234
.325 and .350.	28,496
.40	58,323
.50	65,042
.60	39,078
.80	14,213
.92	2,516
1.00	2,494
1.10	5,988
1.30	1,338
	1,370,427 = 851.55 miles.
Cast iron	1,307,422
Sheet iron coated with bitumen	57,790
*Lead	3,877
	1,370,427

In addition there are of concrete pipe 1.50 m. in diameter, 1,398 feet.

* Some lead pipes are used up to 5¼" diameter.

In addition to the foregoing, the sum of $180,000 was required to continue the distribution, pipes, etc.

NOTE.—The linear dimensions given here in meters are not reduced to English feet, because of the facility with which it may be done by the reader. The number of meters divided by 0.3 gives the number of feet, within 1½ per cent., which is quite near enough for ordinary purposes. Example: 2 meters ÷ 0.3 = 6.66; but 2 meters are exactly 6.56 feet, difference 0.1 foot.

Reservoirs.	Elevation of surface above River Seine. Feet.	Quantity of water contained. Cubic feet.
Spring water:		
Montrouge	175.25	10,780,000
Menilmontant (upper reservoir)	267.80	3,534,000
Belleville,	358.20	220,528
Artesian wells of Grenelle	152.60	.....
" " " Passey	88.28	.....
" " " Butte Aux Cailles	.....	.....
" " " Place Hébert	.....	.....
River water:		
Passy (3 basins)	161.02	1,380,640
Monceau	84.51	353,470
Racine	67.48	145,629
St. Victor	72.70	238,600
Vaugirard (2 basins)	76.80	331,500
Panthéon	151.27	134,300
Menilmontant (lower reservoir)	242.68	1,007,300
Belleville, " "	345.57	415,800
Gentilly (old and new)	184.76	236,800
Charonne, " "	179.12	199,700
Buttes Chaumont	239.58	311,000
Montmartre	206.75	35,000

CORRESPONDENCE.

C. H. T., WILKESBARRE, Pa.—We have several orders for Wellington's "Economic Theory of Location of Railroads," which we cannot fill. We submit your offer of $5 for the volume if delivered in ten days from 13th inst., and will send it if obtainable.

N. C. R., WEST HAVEN, CONN.—A. M. Wellington's "Economic Theory of the Location of Railways" is the work which you are in search of. It is out of print, and quite unobtainable at any price, but a new and improved edition is in preparation.

F. V. R., HAVANA, CUBA.—The Transactions of the A. S. C. E. are only issued to members, and exchange publications. We believe it is allowable, however, to get copies through members who can buy extra ones from the Secretary at a price fixed by the Directors. We do not know the price.

C. D. W., CLEVELAND, OHIO.—We do not know where a description of the Heberlain brake can be found, but think it was published in the *Railway Engineer*, London, Eng. Inquiry in this city, where the information is supposed to exist, has been unsuccessful of results.

W. B. T., BEARDSTOWN, ILL.—The American Society of Civil Engineers, on June 10, 1874, adopted a report "On the Form, Weight, Manufacture and Life of Rails," by Messrs. Welch, Forney, Chanute and St. John. There is a considerable amount of literature on the subject in the library of the American Society. We do not know what the practice of the Society is about giving information to non-members, but you can address Secretary Bogart on the subject.

J. M. H., ST. LOUIS, MO.—We publish from time to time the news from Mexico, and have now on our exchange list several Mexican journals from which we hope to "post" our readers. To reach the City of Mexico, the steamship *Whitney* leaves Morgan City on the 1st and 16th and Galveston on the 2d and 17th of each month. Cabin passage, $50; steerage, $25; round trip, $90; all from Morgan City to Vera Cruz. The steamship *City of Merida* leaves New Orleans Jan. 8, and every three weeks thereafter, for Vera Cruz, via Matamoras, Tampico and Tuxpan. The N. Y., Havana and Mexican Mail S. S. Line steamers leave New York for Vera Cruz, via Havana, every Thursday. Of this line the *British Empire* goes to Havana only, so that intending travelers would have to "lay over" in Havana for the next steamer. From Vera Cruz to City of Mexico by rail.

THE COUNCIL BLUFFS WATER-WORKS.

COUNCIL BLUFFS, Iowa, Jan. 3, 1881.

EDITOR ENGINEERING NEWS:

I inclose you herewith amount due you on last advertisement for city water-works. We have not yet contracted for water supply, but have written to parties engaged in building works, inviting them to come and see us, and if an agreement can be reached we will then give the successful party a franchise. We have tried long enough on an *ex-parte* ordinance, and now want parties to come and see us, look over the ground, and tell us what they are willing to do, and if their terms suit us we will contract with them. Water-works ought to pay well in Council Bluffs. Our railroad interests are large, pork-packing interests large, stock-yards and other concerns here that would be heavy consumers of water. Our city has about 20,000 people, and has the promise of a continued healthy growth. We expect four or five parties here during the present month to look over the field with the view of making us some sort of a proposition. We expect to pay a reasonable price for water for fire and other public purposes, and will give a fair, liberal charter.

JACOB WILLIAMS,
Chairman Water Committee.

ERROR IN CALCULATING FROG DISTANCES.

ALLEGHENY, PA., Dec. 30, 1880.

EDITOR ENGINEERING NEWS:

I desire to call your attention to an error in the formula for calculating frog distances, etc., as given on page 40 of the "Road-Masters' Assistant." In this formula the switch-rail is assumed as being part of the turnout or lead-rail, in which case the radius of the same is at a right angle with the main line or track, where it is a straight line or tangent.

Where the angle of the frog and the gauge of the track are known, it is an easy matter to find the frog distance, as we have all the requirements of a right-angle triangle; where the rail of the main track represents the base, the gauge the height, and the frog distance the hypothenuse. The formula for the solution is then, the gauge divided by the sine of one-half the frog angle. In order to find the corresponding radius, we divide one-half the frog distance by the sine of one-half the frog angle.

Now, to find the length of the switch-rail. To do this, it is necessary to know the throw of the same, where stub-toe switches are used. Of course, where split-switches are used, the length of the switch-rail is, for obvious reasons, immaterial, forming, as it does, part of the continuous lead-rail, and being moved at the heel instead of at the toe, as in the other case. On the assumption that the throw of the switch-rail equals the middle ordinate of a chord, of which the switch-rail would be one-half the length, we would have the switch-rail equal

$\sqrt{(R-\text{throw})^2-R^2}$, instead of $\sqrt{(R+\text{throw})^2-R^2}$,

as stated on the page mentioned in the "Road-Master's Assistant." In this formula, it is supposed that the length of the switch-rail is to be measured along the main track, when it should be measured in reality along the switch-rail itself. In this case the proper formula would be, where c is the length of the switch-rail, d the throw of the same, R radius of lead-rail, then

$$c = \sqrt{d\,2R}$$

Respectfully, EMILE LOW.

EADS' SHIP RAILWAY.

KANSAS CITY, MO., Dec. 28, 1880.

EDITOR ENGINEERING NEWS:

The recent exhibit of Mr. Eads' scheme for a ship railroad in the *Scientific American*, and his present absence in Mexico, will bring the project of railroad *versus* canal prominently before the American public.

As this problem is studied the idea of injury to the ship will be dismissed, for as stated in his exhibit no strains can be brought upon a ship by the cradle in any manner equal to those continually met at sea.

The strains of flotation are hardly considered in ocean ship building. When built, the ship is an immense girder sustained by from three-fourths to seven-eighths of its length, the ends, so far as flotation is concerned, overhanging. But it must be capable of being held alternately by the ends and center, not only in quiescence, but handled by the shock of great waves, to which the injuring power of a cradle would be a bed of egg shells. Mr. Eads proposes 12 lines of rails, 4 or 5 feet apart, say 5 feet; as the track will even then be too narrow (55 feet) wheel centres cannot follow each other at an average distance of much less than 3½ feet, then each wheel would have to carry 3½ × 5 feet of the vessel.

The draft is supposed to be 26 feet; say it averages 25 feet for a maximum of midship section. The equivalent of this amount of sea water may be considered as the maximum load upon any part of the cradle, each wheel therefore carrying, besides its own adjuncts, the equivalent of 437 cubic feet of sea water, or about 14 tons.

As this is nearly triple what Mr. Eads proposes to put on one wheel, it will be doubted whether he has tracks enough.

Another point in his exhibit is the use of the ordinary marine railway bilge blocks. Under these blocks I have crushed cast-iron rollers six inches in diameter, and do not see how a perfectly equal distribution of weight can be made by them. In the ordinary marine railway a double track carries the keel blocks, on which a large part of the weight is borne, and the bilge blocks carry a lesser amount, the danger of overloading these by getting them too far under the ship being incidental to the necessity of using them for keeping the ship on even keel, unequal settlement, and uneven tracks.

In the proposed railway the center tracks have not the ability to carry greatly in excess of their proportion of the load, and in general any uneven distribution of weight would be liable to crush the wheels bearing it. Therefore the point to be studied is not the safety of the ship, but of the

carriage, and in this I believe the mode of support proposed in my article in ENGINEERING NEWS last January has some points of superiority over this.

Briefly, using hydraulic lifters fed from a common source as a mode of equalizing strains.

Allowing a lifter to each four wheels, the maximum strain at five tons per wheel would be but twenty tons per lifter; if eight inches in diameter, the pressure would be but 800 pounds per square inch, a pressure within the ability of light weights of metal to hold and of ordinary stuffing boxes to keep tight, in this particular practically free from the objections to ordinary hydraulic lifters working under great pressure.

These, in connection with the flexible barrels joining their tops, permit a support of the vessels closely approximating to flotation, are capable of adjusting themselves to the inequalities caused by bilge keels or wales; being interchangeable are readily adapted to different models, and permit the spreading of weight over any desired breadth of tracks, especially near the ends of the vessel where the weight otherwise might be with difficulty sufficiently distributed.

Believing in both the scheme, and the man who is endeavoring to bring it forward, I only wish to add to the eminently practical means by which he has solved the more difficult parts of the problem some details which I believe equally practicable, as a part of those which may finally be brought into requisition for the work.

G. W. PEARSONS.

GAS ASSESSMENT FOR STREET LIGHTS.

Gas for the purpose of lighting street lamps is delivered either from private corporations or from works owned by the municipality; but the money which is to pay the expense of lighting must be raised by some form of taxation.

The method used by most cities is that of assessment, and the collection of the same by the authorities who collect the general taxes.

Street lights benefit every inhabitant of the municipality, but not in the same proportion.

Those who live on a street which is lighted, receive more than those who live outside the district so lighted.

This benefit may be divided into two parts:

First. That which uses the light for "convenience of travel" only, and,

Second. That in which the light is considered to be used as a police regulation, by protecting the property abutting on the streets lighted.

Assessment may be made in three ways:

First. Taxation of the entire cost of lighting on the entire real estate and personal property of the city, without any reference to the number of streets which are lighted, or to those which are not lighted.

Second. Taxation of the entire cost of lighting only on the real estate abutting on the streets lighted.

Third. A combination of the two foregoing methods.

The first method taxes those who live beyond the district lighted to the same extent as those within the district. This is unjust, as they receive only benefit by travel and none as police regulation, besides it has the tendency of lighting a large number of streets when there is no necessity for the same. Generally, it is used by those cities which own the works, but not exclusively by them only.

The second method taxes generally by a rate of —— cents per front foot of only that real estate which abuts on the streets lighted. This, however, allows those outside the lighted district to travel by gas-light, free of charge, and is, therefore, in this respect, unjust.

The third method, which is, as far as I am aware, a new one, and but little used, taxes on the real estate and personal property a certain part of the entire cost of lighting, and then assesses the remainder of the cost of lighting on the abutting property of streets lighted, by a rate regulated by the value of the property as it appears on the tax duplicate.

This method therefore attempts to divide the cost according to the benefits received.

That portion which is levied on all property is assumed to pay for the conveniences of travel, and that which is assessed on the property which abuts the lighted street pays for the light as a police regulation. Here again it is assessed by the value and not by the foot frontage as a standard, which, as a police regulation, is certainly just; value can only be protected by police regulations. This method seems, therefore, to be a very just one. In lighting the streets not yet lighted, if the posts are paid for by the municipality, the abutting property should pay for this alone, as the same property has, up to the time of erection of posts on its street, paid for convenience of travel and must therefore pay for the posts as a police regulation only.

As this method is new I shall cite the following data as an example.

Value of all real estate and personal property of a city is assumed to be	$18,000,000
Value of real estate which abuts on streets lighted aggregates	9,000,000
Assume entire cost of lighting to be	22,500
Rate of the portion assumed to be used for convenience of travel is 5-10 of one mill on each $1 at this rate for 18,000,000 obtains	9,000
Which leaves as a remainder, $22,500—9,000 the sum of	13,500

which would require for the value of $9,000,000 a rate of 1.5 mills on one dollar valuation. Hence those outside of the district lighted pay on each $100 value the sum of five (5) cents for the convenience of travel; while those within the district pay for the same purpose an equal amount, and besides for a police regulation they pay fifteen (15) cents, or a total of twenty (20) cents on one hundred (100) dollars valuation.

The last method could also be adopted for the purpose of extending hydrant service of waterworks.

W.

THE ERECTION OF IRON BRIDGES.

At the meeting of the Institution of Civil Engineers, held on Tuesday, Dec. 7, Mr. W. H. Barlow, F.R.S., President, in the chair, the paper read was on "The Different Modes of Erecting Iron Bridges," by Mr. Theophilus Seyrig, M. Inst. C.E., of Paris. The various modes were ranged by the author in four classes: 1. Erection upon staging. 2. Erection by lifting bodily. 3. Erection by rolling over. 4. Erection by building out.

1. In erection upon staging, the timber piles or standards were either spaced in rows at equal distances apart, or clustered together, leaving wider spaces between the clusters. The use of standards equally spaced was illustrated by descriptions of the timber-stagings employed in the erection of railway bridges over the Theiss, at Allgyö in Hungary, with 328 ft. span; over the Erdre, at Nantes in Brittany, with 321 ft. span; and over the Thaya, at Znaim in Moravia. As examples of clustered standards, the timber-stagings were described of the Pont du Carrousel, Paris, with 157 ft. spans; Bordeaux Bridge with 253 ft. spans; the railway bridge over the Lek, at Kuilenburg in Holland, with 492 ft. span; and Bommel Bridge over the Waal, with 393 ft. spans. A light, iron platform, suspended from chains was employed for erecting the El Kantara Bridge in Algeria, at a height of 393 ft., with 194 ft. span. Light iron lattice girders, supported on clusters of timber piles, were used for erecting the railway bridge over the River Inn, at Königswart, in Bavaria, with three spans of 237 ft.; but the intermediate piles in the middle span having been swept away by a flood, a temporary wrought-iron frame-work, stretching across the entire opening, was erected by overhang; its panels advancing from the piers at each side, and meeting midway. Erection upon staging involved the cost of a temporary structure, the whole of which had to be removed after the completion of the permanent work. In many cases this cost was compensated by rapidity, convenience, safety, and cheapness in the erection of the bridge. The danger incurred by staging constructed across rivers liable to floods and drift was exemplified by disasters to the staging at the Hamm railway bridge in Rhenish Prussia, crossing the Rhine with 340 ft. spans; by settlement of the staging at Kuilenburg Bridge; and by the mishap at Königswart Bridge. Otherwise staging afforded safety and facility for erecting the permanent work, which latter was subjected to no undue strain prior to its completion. Rapidity of erection upon staging was illustrated by examples of bridges put together on the American system of pin connection, without riveting.

2. Erection by lifting bodily had its origin at the Britannia Bridge in 1848, the four large tubes of 470 ft. in length being constructed on shore, and floated upon pontoons into position between the piers. The plan was imitated at the Saltash Bridge for the two large spans of 455 ft.; and at the railway bridge over the Weser, near Bremen, in 1867. The railway bridge at Moerlyk, in Holland, having fourteen openings of 328 ft., had lately been erected in a similar way; by aid of the tide the girders constructed upon the bank were floated on pontoons, first to an intermediate halting place, and thence to the bridge piers. At Niagara Bridge, spans of 197 ft. and 248 ft. were erected upon a floating staging, consisting of a platform carried on pontoons. Erection by lifting bodily admitted of large girders being constructed conveniently and in a safe situation, whence they were afterward floated in a few hours to their intended position; the difficulties were thus concentrated at the fewest points, and the danger was limited within the shortest time. It required, however, the employment of a special gang of bargemen; and involved a considerable outlay for pontoons and tugs, which on a very large work was more than recouped, but not on a small number of spans or light girders.

3. Erection by rolling over is applied to continuous girders extending over two or more spans. It involved the principle of planning the work with regard not only to its final purpose, but also to the means whereby it was to be carried out. The facility of erection by rolling over led to its original adoption for the Sarine Railway viaduct at Freiburg, in Switzerland, where the roadway was constructed on the hill, behind one of the abutments, and then by means of windlasses was pushed bodily forwards upon rollers across the successive openings of 160 ft. between the piers. A similar method was carried out for Stadlau Bridge, at Vienna, crossing 232 ft. spans. At Waldshut Bridge, over the Rhine in Switzerland, the windlasses were replaced by ratchet wheels keyed on the roller spindles, and worked by levers, whereby the rollers were transformed into driving rollers, and the use of hauling ropes was dispensed with. Erection by rolling over presented the advantages that the main work of constructing the bridge was carried on in safety and convenience upon the bank, the actual rolling was attended with but little expense, and the plant used could be again employed. It was limited, however, to continuous girder bridges; the bottom booms of the girders must be of I-section; and the lattice sides must be strong enough to withstand considerable compression, and prevent the bottom booms from bending dangerously. The bottom booms were strained by repeatedly passing over the rollers, with changing direction of the strains, and the joints of the lattice bars were liable to be injured thereby. For the replacing of existing bridges by new work in a very speedy way, the new roadway had been erected alongside the old one, and had then been rolled into its place sideways. On railways in Hungary and Austria a number of timber spans, varying from 26 ft. to 210 ft., had thus been successfully replaced. A description was given of the operations at Hernad Bridge, on the Oderburg & Kaschau line, where two 82-ft. spans were thus renewed with only about four hours interruption of traffic. In the renewal of one of the Prater bridges, on the Austrian State Railway near Vienna, the new bridge of 350 tons weight, constructed of bowstring girders of 200 ft. span, and carrying two lines of way, was rolled into position upon a live set of old cannon balls, instead of upon rollers; the same device had previous been used in renewing a single-line bridge over the Waag, at Tornocz. Rolling had also been applied to the temporary timber staging employed for the erection of the permanent structure. This method was illustrated by the successful erection of Saint Just road bridge over the Ardèche, in France, with 152 ft. clear openings spanned by arched wrought-iron ribs. Another example was Regoa Bridge over the Douro, in Portugal, with spans of 162 ft. and 263 ft.; here the rolling timber stage got so strained in the earlier operations

as to require the support of intermediate timber piers in crossing the later spans.

4. Erection by building out, in which the permanent structure was made use of for its own erection, dispensed altogether with extraneous appliances, these having been successively less and less depended upon in the modes of erection previously described; lifting bodily required less plant than staging, and building-out still less. El Cinca Bridge, in Spain, the first erected by building-out, had an arch of 230 ft. span, each half of which was erected as a cantilever or wall-bracket projecting from the abutments until their ends met midway. At the steel bridge over the Mississippi, at St. Louis, with two side arches of 502 ft. span and a central one of 520 ft., the half arches were erected from the masonry piers, proceeding on both sides of the pier simultaneously, so that the lateral strains should counterbalance one another. The most recent example of erection by building-out was the railway bridge crossing the Douro, near Oporto, with a crescent-shaped arch of 525 ft. span, the height of the extrados at the crown being 200 ft. above the water. The abutments and the iron piers on each bank having been first erected, and the continuous roadway girders having been pushed across them far enough to overhang the arch 105 ft. at each side, the arch itself was then erected panel by panel from the springing, the overhanging panels being successively supported by wire ropes tying their outer extremities to the horizontal girder overhead, where it rested on the pier. The principal details connected with the erection of this bridge were described at length, as an example of work carried to a completely successful issue under conditions insuring great safety. Exceptional cases apart, iron bridges of all kinds, from arched bridges to lattice swing bridges, admitted of being erected without the use of auxiliary girders or staging, and under good management it seemed likely that such independent modes of erection would most frequently prove economical.

The paper was illustrated by a series of diagrams, in which red color was used to distinguish the temporary staging or other extraneous appliances for the erection of the permanent work, while the permanent structure itself was colored blue.

CAPTAIN EADS' SHIP-RAILWAY.

TERMS OF THE MEXICAN CONCESSION.

[Correspondence of the New York Tribune.]

MEXICO, Dec. 21.—Captain Eads has completed his negotiations with the Mexican government for the construction of his ship-railway across the Isthmus of Tehuantepec, and has received from it the most liberal concession which it has ever granted. It gives him the right to construct the ship-railway on such line as he may determine, and he is to be entirely untrammelled in the plans and execution of the work, which is to be commenced within two years from the date of the grant and completed within twelve years. The concession grants a right of way across the isthmus half a mile in width, which width is increased, wherever stations are required, to one mile. It gives him the right to improve such rivers and harbors as he may deem proper, and to collect liberal tonnage tolls from vessels entering them. It permits him to collect $5 per cubic meter of the displacement of each vessel transported on the railway; the amount of tolls to be determined in the following manner: The greatest length and greatest width of the vessel, measured at the surface of the water, are multiplied by the greatest depth of immersion, and for each cubic meter or fraction of a meter contained in such parallelopiped of these dimensions, he is entitled to charge $5 toll. He is also entitled to charge $15 for each passenger on the ship, and 1 per cent. on the value of gold or silver coin or bullion or precious stones; and, in the event of such valuables not being declared to his agent, to collect 10 per cent. on their value, and to detain the ship until the sum is paid. He is also entitled to such compensation as may be agreed upon between his agents and any vessels in transit, for dockage, repairs or cleaning, when needed by them, and to operate a telegraph line and an auxiliary freight and passenger railway line in connection with the ship railway. In addition the government grants him a subsidy equal to 1,000,000 acres of public lands, to be located on the isthmus or elsewhere, in aid of the construction of a suitable harbor on the Pacific Ocean. It also gives him the right to consolidate the Tehuantepec Railway, now being constructed by M. Learnard and others, with the ship railway on such terms as may be agreed upon between them, and in such event, the location of the Tehuantepec Railway may be altered as desired by Captain Eads.

The Tehuantepec Railway Company has a subvention amounting to about $1,500,000 to be paid by the Mexican government in custom-house certificates, and has also a large land grant. In case of the acquisition of this railway its obligations to the Mexican government are to cease and determine, and the subvention would then attach to the ship railway. The duration of the grant is ninety-nine years, at the termination of which the government is to take possession of the works and pay two-thirds of their value. Captain Eads, on his part, agrees to transport the ships, property and troops of the Mexican government without compensation during the existence of the grant. He has the right to export, free of all duties, all moneys required to pay dividends or to purchase materials of any kind for the use of the road, and likewise to import, free of duty, during the entire period of the grant, all materials, coal and articles of every kind required for the construction, repair and operation of the road.

The most remarkable feature, however, of this liberal concession is that which gives to Captain Eads the right to hypothecate the revenues of the road to any other government which he may select to aid him by money or guarantees in its construction. It gives to such government, in case of any default on the part of the company to such government, the right to intervene through the courts of Mexico and have receivers appointed to insure the faithful application of its revenues in accordance with the terms that may be agreed upon. No hypothecation or conveyance of the grant or of the works themselves, or of the lands, however, can be made to any foreign government without invalidating the concession.

The permission to secure the co-operation of another government is intended by the Mexican government to give to the United States the privilege of co-operating with Mexico in aid of the construction and control of the works, as this is regarded by the leading men in Mexico as the American route across the isthmus, and the one in which these two republics are most vitally and directly interested. The route across Panama, which is distant 1,200 miles from Tehuantepec, is called in Mexico the French or European route. Ships from New York to San Francisco would save about 1,500 miles by going by way of Tehuantepec instead of by Panama. The one route is through the Gulf of Mexico and the other through the Caribbean Sea. From the mouth of the Mississippi to California by Tehuantepec is 2,300 miles less than by Panama.

The tolls which Captain Eads is allowed to charge are nearly three times as great as those which are allowed in the Colombian grant to the De Lesseps party. This is done for two reasons; first, the railway across the Mexican isthmus will need to be about 112 miles in length, as against forty-five miles at Panama; and second, the great saving in sea distances in favor of Tehuantepec will justify much higher rates of toll.

The tolls allowed Captain Eads, even assuming that the actual tonnage will be only one-third as much as that estimated by the Paris convention, will, it is thought, insure such profits as will enable him to secure sufficient private capital to construct the railway. A canal at Panama, at the lowest estimates that have been made for it, will be largely more than double the cost of the ship railway at Tehuantepec, which Captain Eads estimates will be $75,000,000. He, however, proposes to give to the United States the right to lower these tolls to any point deemed advantageous to the interests of American commerce, and to transport its ships, property, officers and soldiers gratis, on condition that it will guarantee six per cent. dividends on $50,000,000 of the stock of the company. He insisted on the insertion of a clause which would permit the United States government to lend its aid to this work, and declared to the President and Cabinet of Mexico and to the leading members of its Senate and House that such a clause would be looked upon by the United States as an evidence on the part of Mexico of confidence, likewise as an evidence and a desire to cultivate the kindliest relations with the United States. The greatest delay in obtaining the concession resulted from Capt. Eads insisting that such a clause should be inserted in the grant, and from his declaration that he would not consent to appeal to capitalists or to any other government without first giving to the United States this opportunity.

The utmost unanimity prevails in this country with regard to the practicability of the ship-railway. Not a word has appeared in any of the papers of Mexico expressing a doubt of it, nor have I heard such doubt expressed by any one in the country. The people seem to accept the success which has attended the engineering works of Captain Eads as an ample guarantee of his ability to carry out what he proposes, and, while his reception here has been devoid of any theatrical display, the manner in which he has been received and treated by the Mexican government and people has been a source of the liveliest gratification to American residents in Mexico. At his request a costly expedition, comprising about fifty individuals—engineers, assistants, laborers and soldiers—to assist him in making a survey of the isthmus to determine the most practical route for the ship-railway, has been prepared by the Mexican government and has started for the isthmus. This commission is under the direction of the eminent civil engineer, Francesco De Garay, who is in charge of the drainage of the Valley of Mexico, and who was commissioned to represent the Mexican government at the Paris Canal Convention. He is directed by the government to assist the engineers of Captain Eads in the instrumental survey of such routes as he may designate. Messrs. Williams and Corthell will direct the survey during the absence of Captain Eads, who has started with the expedition to the isthmus to inspect the rivers and harbors, and give the party such instructions regarding the work as he may deem necessary. As an additional evidence of the respect of the government for Captain Eads, it has ordered one of its war vessels, the Independencia, to take him from the isthmus to the port of New Orleans, on his way to Washington.

THE PANAMA CANAL.

[Boston Advertiser (Rep.), Jan. 3.]

There can be no doubt that the financial aspects of the Panama Canal, as far as known, are no more satisfactory than the political elements here briefly alluded to. M. de Lesseps has asked all the world to pay him $60,000,000. For this he will build the canal. Until the canal is complete the shareholders will draw 5 per cent. in annual interest. Some such management was possible at Suez, where the unhappy Khedive furnished more laborers and more cash than accessible accounts report. It was possible with the Pacific Railroad, which was largely guaranteed by the credit of the United States, and still owns a whole kingdom of fertile lands. The men who bought the shares and bonds of the road received an equivalent, very much as a man who takes a national bank bill receives substantial value. The owners of Panama stock, as far as human eyes can see, receive only the promise of value or possible value—prospective value. There is neither Egypt nor America to fall back on in case of a deficiency. Where, then, is the interest to come from until the canal will be earning money? If it be supposed that the canal is complete in ten years and that $60,000,000 will build it, is it not evident that $30,000,000 have to be paid out in interest alone before the canal will earn anything? Even if the $60,000,000 were signed and paid in, what would be left for building purposes after the annual interest, the salaries and the incidental expenses have been paid? M. de Lesseps surely owes the world some explanation of this remarkable financiering.

THE GAS TRUST OF PHILADELPHIA.

The history of the Gas Trust of Philadelphia, which has for so long enjoyed the monopoly of manufacturing the gas consumed by the people of the City of Brotherly Love, proves that the manufacture of gas is exceedingly profitable. It would seem from the history of the Trust that in 1835 the city authorized certain persons to raise a capital stock of $100,000 for the purpose of constructing works to supply the city with gas. The subscribers received certificates for their stock which entitled them to the profits arising from the sale of gas, and though the city was not to be liable for any sums besides the subscription of $100,000, it provided that the gas works should be under the exclusive management of twelve trustees, who should be elected by the Councils of the city. The city also reserved the right to take possession of the works and convert the stock into a loan. The demand for gas soon growing beyond the capacity of the limited capital of the trust, the city authorized loans to provide the new works upon the credit of the city. Besides the security of the gas works, a sinking fund was also provided for, and proceeds of sales of gas were set aside as security for the loans.

In 1841 the city bought out the stockholders of

the Gas Trust, paying them $125,000 of six per cent. bonds, and $48,000 of five per cent. bonds, the stockholders also having the net profits from the gas works to that time. The management of the works was continued the same as before, however, to protect the bonds thus outstanding. How profitable the manufacture of gas has since proved is shown by the fact that down to Jan. 1, 1879, the loans created for the purpose of developing the gas works have amounted to $8,120,740. Of this amount there was outstanding.

Jan. 1, 1879	$6,300,740.00
In sinking funds	3,555,888.92
Leaving the net outstanding loans Jan. 1, 1879, for which the city was liable, at	$2,744,851.08
The Trustees, Jan. 1, 1879, estimated the value of the works, street mains, services, meters, etc., at cost, at	$11,172,389.58
There has been paid and set apart as a sinking fund for the redemption of loans	5,388,740.53
	$16,561,130.11
From which deduct the total amount of loans and stocks	8,120,740.00
Leaving the amount paid out of the profits and interest upon investments	$8,440,390.11

Showing the net value of the works to the city.

With this showing, it is not to be wondered at that the citizens of Philadelphia are clamoring for cheaper gas, and claiming that the exorbitant prices of the past have enabled the Trustees to not only pay the interest upon the capital engaged in manfacturing gas, but to create that capital itself.

The citizens are now agitating the question of taking the works out of the hands of the present Trustees, but are met by the claims upon the part of the Trustees that no change can be made until the last of their loans expire, which is in 1885, although at the present time there is in hands of the Trust more than double the amount of the loans of 1885.

THE NEW YORK STATE SURVEY.

The field work of the State Survey for this season has just been brought to a close by severe storms, and the assistant engineers have returned to the office in this city, bringing with them many hundreds of observations for determining the geographical positions and elevations of hitherto unlocated cities, villages and prominent points in the State. The most striking result of this year's work is the completion of the first accurate measurement across the State. Strange as it may seem, the distance from the eastern to the western boundary of New York has never been precisely measured until now, and the best maps represent the width of the State quite different from its true dimensions. The result of the State Survey measurement can hardly be announced for two months, owing to the labor of computing the observations. Besides this valuable contribution to geographical knowledge, the division engaged on the Mohawk triangulation has determined the geographical positions of some twenty-six cities, villages and settlements in Oneida and Montgomery Counties. Although the work is by no means complete, it has gone far enough to prove that the people do not know, with even approximate correctness, the area of a single one of the important counties lying along the Erie Canal and crossed by the triangulation of the State Survey. On the Hudson River, and on Staten Island, a system of enduring reference monuments has been placed, by which the position of the "bulk-head line" may be exactly fixed and always found. A commission of United States engineers determine by law the limits beyond which no wharves or obstructions can be carried into the channel of the Hudson River or the waters around Staten Island. The proper determination and preservation of this bulk-head line are of vital importance to navigation. Two surveying parties have been engaged on this duty since last May.—*The Albany Argus.*

The first detachment of engineers and workmen were to start on Jan. 5 to prepare for the beginning of the Panama Canal.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

The sum of $100,000 has been asked by the Finance Committee for the extension of the Philadelphia Waterworks.

City Surveyor O. H. Buckman, of Napa, Cal., has made a report on the scheme for a water supply of the town. He estimates the total expense of the works at between $75,000 and $100,000, according to the pipe used.

The Newark, N. J., Aqueduct Board of 1881 organized Wednesday night by the election of the regular standing committee. The superintendent made a statement that the driven wells were running daily and yielded nearly 5,000,000 gallons of water.

Within a week or two Silver City, Col., will be supplied with water by the Holly system, Smith's Springs, a mile and a half to the west, being the source, and furnishing a most cold and pure fluid. Twenty-nine fireplugs have been placed throughout the city, and mains of eight, six, four and three inches laid in position. At present water-carts haul the water from the springs and deliver it through the town, forty cents a barrel being asked.

The Orange (N. J.) Water Company was organized Thursday evening, 30th ult., by the election of seven directors. The capital has been placed at $100,000, and stock representing three-quarters of the whole is subscribed. F. M. Shepard, President of the Goodyear Rubber Company, was elected President of the Water Company. The water supply will be ready for use next summer. It will be procured either from Verona Lake, in the Orange Mountains, and conveyed through a five-mile conduit, or wells will be excavated, like the one at Garden City, L. I.

ELECTRICITY.

Experiments have determined that the attempt to light the Hoosac tunnel by electricity is successful only when the tunnel is clear of smoke.

The United States Electric Light Company has purchased the large building at Avenue B and Seventeenth street, New York City, intending to use it as a manufactory of the Maxim lamps and other electric apparatus. This will be the largest shop in the world devoted to such purposes.

QUINTUPLE TELEGRAPH WIRES.—CHICAGO, Dec. 30.—The *Times'* Boston special says: "The Western Union Telegraph Company has for six weeks been experimenting between this city and New York with a new invention whereby five messages may be simultaneously sent from each end of the line, and so far, it is said, the contrivance has proved satisfactory. The principle involved is that which underlies Professor Elisha Gray's telephone, that by vibrations of tuning forks, tones of different pitch can be sent over the wire simultaneously and separated at the receiving end by ingenious contrivances. A vibratory tuning fork at the receiving end is made to break the circuit so as to deliver a message in the Morse alphabet. The Western Union Telegraph Company is said to have offered the inventor $150,000 if he shall succeed in using one wire for four simultaneous messages, and $25,000 for each time a message is superimposed after that. As stated above, six weeks of trial are successfully past, and it is stated that on the 21st instant five operators in New York and five in Boston, using one wire, sent and received twenty-one hundred and thirty messages, or forty per hour for each man."

STREETS, DRAINAGE, ETC.

The Street Cleaning Bureau of New York employs 1,005 men and spends $657,745 annually, of which $119,950 is said to be expended to supervise the expenditure of the balance.

There is a great movement to have wood paving in England, but although it has proved generally satisfactory, the experiment in Edinburgh has been a failure, owing, doubtless, to bad laying, and the quality of the wood. Hard-stone pavement is to be again put down.

Mayor Kalloch has been explaining about the sewer contracts of San Francisco. He says that he went lately to the Superintendent of Streets and asked him if 63 cents per front foot was a fair price, observing that he would sign no contracts which were not reasonable. Subsequently the original contracts were replaced by others at $1.20. The matter has been referred to a committee.

Samuel Crump, of Montclair, N. J., has recently lost his wife and four children by diptheria. Five out of the six members of the family have fallen victims to the disease. The cause of the disease has been found in defective sanitary arrangements in the building of the house, which was believed to be fitted with modern appliances. But by defects in the pipes poisonous gases entered the sleeping-rooms of the family with fatal results.

The contemplated improvement of the Michigan Avenue Boulevard, Chicago, will cost $551,063. If the assessment is confirmed, the Park Commission will at once proceed with preparations for the improvement in the hope that the work will be under way early in the spring. The plan of improvement decided upon contemplates flag-stone sidewalks, eight feet in width, grass plats between the walks and the stone curbs, in which elm trees shall be supplied where not now growing within proper distance, uniform lamp-posts and a driveway, eight feet of the sides of which shall be of stone or composition block, and the center, thirty-four feet, of which shall be a surface of six inches of clear bank-gravel upon a foundation of twelve inches of limestone macadam.

BRIDGES.

Cape Girardeau County has paid out over $10,000 for bridges during the past year.

At the January meeting of the trustees of the East River Bridge, the action of the Executive Committee was ratified, awarding the contract for the bridge in the New York approach over Franklin square to the Delaware Bridge Company for $120,000. The contractors are to give bonds for $25,000. The financial statement showed that the total receipts to January 1, 1881, were $12,644,841.68, the expenditures $12,575,403.09, and the cash on hand $69,438.66. In response to a question from John T. Agnew, asking what progress was making by the Edgemoor Company under its contract for furnishing steel for the superstructure, President Murphy read a letter from Engineer Paine, who is superintending the work. He stated that the Midvale Steel Works had received from the Cambria Iron Works 2,887 tons of the steel blooms for the bridge (about half the entire quantity), and 1,160 tons had been rolled and sent to Edgemoor to be manufactured. Of the floor beams, made in two sections, 77 sections had been made and 230 steel trusses.

RAILROADS.

The Houston & East & West Texas Line is to be extended to Tyler.

The building of the line from Pesth to Semlin, Austria, will require about 24,000,000 florins.

The Texas Pacific is now completed to nearly the line of Taylor and Gallahan counties, Texas.

Governor Rice, of Massachusetts, and Mr. J. B. Allen will probably purchase the Texas Western Line.

The track of the Southern Pacific is now laid 254 miles east of Tucson, or 1,232 miles from San Francisco.

The contract from Greenville to Mineola (Tex.) has been let to John Scullin, and workmen will be put on the line at once.

Captain Loomis continues to push work on the Santa Fe (Tex.) Railroad. The bridge across the Leon River is now completed.

The track on the Texas & Pacific extension is going down at the rate of a mile a day. The grade is now completed 200 miles west of Fort Worth.

Persia has a railroad. No men are allowed to enter the women's car, the occupants of which pass their fare out to the conductor through a small hole like that of an omnibus.

M. Boutoux has not accepted the offer of the Servian government for the concession of 400 kilometers of railroads. A Russian house has almost closed with the government.

An application for the concession of a railroad from Sorocaba, in San Paulo, to the City of Coritiba, in Parana (Brazil), has been made by two Brazilian engineers.

The United States Circuit Court has refused to grant an injunction in the suit of the Pullman Palace Car Company against the Baltimore & Ohio Railroad for an infringement of patent.

The L. & N. road is extending its Knoxville Branch from Livingstone, Ky., to the Tennessee State line, where it will be met with Knoxville & Ohio R. R., which will make a very important connection.

The Hon. George S. Boutwell, President of the Massachusetts Central Railway Company, will seek, at the Massachusetts Legislature, an extension of time for the location and construction of that line.

The contract work on the Texas Pacific has been accepted to a point 171 miles west of Dallas. The high bridges west of that point are finished. The construction company is getting along fast in Taylor and other counties.

Prof. Webster Wells, late of the Massachusetts Institute of Technology, has patented a device for heating railway cars by the friction of steel plates in a cylinder filled with water, which when heated is circulated by pipes through the cars.

The new year will begin with an enormous demand for first-class railroad bonds, which are difficult to procure. Conservative investors are not to be blamed if they prefer the old standard bonds if the new issues are pushed up to fancy prices.

The South Side Street Railway Company, of Chicago, are trying to obtain permission from the Council to supersede the use of horses on their line by the cable, such as is used in San Francisco. The change would involve an outlay of $2,500,000.

The narrow-gauge roads in Northern Texas are being located rapidly, and new projects are being discussed. The Texas & St. Louis Railroad will build a line from Texarkana to Cairo, Ill., there to connect with narrow-gauge road, which joins the Eastern lines.

The Galveston, Houston & Henderson Railroad will build a branch line from Highland to the bay shore, and cross to the island, three and a half miles above the present bridge. The distance is only one mile, and the depth of water one foot. It is thought better to have an embankment than a bridge. The company also design to construct about one thousand feet front of wharfage, and to build extensive yards, etc.

Mr. J. M. Eddy, Superintendent of Construction of the Mexican extension of the Missouri & Texas Division of the Missouri Pacific, writes to a friend in Chicago that he has commenced locating the new line at three different points, fifty miles of which are already covered with graders. Contracts for a large amount of bridging and railroad ties have already been let, and tracklaying is expected to commence Feb. 1.

FAYETTEVILLE, Fayette County, Texas, Dec. 29, 1880.—A joint stock company has just been organized

here, with a handsome capital to begin operations on, with a view to connecting Fayetteville with the outside world by railroad. The company propose to tap the Central at or near Brenham, or the Gulf, Colorado & Santa Fe at Bellville, or probably connect with the Western Texas Narrow-gauge, which runs from Houston out to Patterson.

The total expenditure in the Canada Pacific Railway to the 30th of November last amounted to $18,600,402. A memorandum of the probable cost of constructing the sections of the Pacific Railway lying between Prince Arthur's Landing and Selkirk, the Pembina Branch, extending from Selkirk to Emerson, and from Kamloops to Fort Moody, including station-houses and water-tanks, gives $28,000,000 as the estimate, which is based on the work now in progress.

The work on the new and extensive buildings of the Pullman Palace Car Company's factories at Kensington progressed with remarkable rapidity until the cold weather set in. There were 2,000 mechanics and laborers employed until within a few days ago, when all out-door work had to be suspended owing to the extreme cold. Thus far nearly $1,200,000 have been expended in the village of Pullman. The factories are so far completed that car-repairing is already being done there. It is the intention to expend $2,000,000 on the works. The Corliss engine, which ran the machinery at the Centennial Exposition in 1876, at Philadelphia, will be placed in position and be in running order in another month.

On Dec. 20, the Southern Pacific Railroad was opened for business to Deming Station, 1,210 miles east of San Francisco, and 45 miles from El Paso. The graders are rapidly approaching the Texas line, and the surveyors are locating the route between San Antonio and El Paso. The company has given notice that the connection will be made by Jan. 1, 1881, with the Atchison, Topeka & Santa Fe Railroad, making another through trans-continental line. The California company will not stop, or even halt, at El Paso, but will push on toward the Gulf, and, as there is a gap of less than 500 miles to be filled, and the Sunset route is being built westward from San Antonio, the shortest American line between the two oceans will be completed within twelve months.

THE COLORADO RAILROADS.—The following are the trunk lines which reach Denver now: The Union Pacific, by way of Cheyenne; the Kansas Pacific, by direct route; the Atchison, Topeka & Santa Fe, by way of Pueblo. Arrangements have been perfected for a third rail from Denver to Pueblo, which will give the Atchison Company a through broad-gauge connection. Denver is connected with Leadville by two roads—the Denver & Rio Grande and the Denver & South Park. The latter is going into the Gunnison now. The former is far into the San Juan and is on its way to New Mexico. By the Denver & Rio Grande and the Atchison, Topeka & Santa Fe, Denver has direct connection with the most distant railroad point in New Mexico. The Colorado Central connects Denver with the thriving young cities on the north. It is doing a very large business. The Denver Pacific runs to Cheyenne and makes connection with the Union Pacific. The Boulder Valley is a feeder of the Kansas Pacific. Within two months Denver will have connection with the Pacific coast by two roads. The first is *via* the Union Pacific and Central Pacific. The second will be completed when the Atchison, Topeka & Santa Fe joins the Southern Pacific. The Mexican lines which are being built will give Denver rail connection with Mexico by two routes. The Chicago, Rock Island & Pacific has purchased the Central Branch of the Pacific, and another trunk line from the East will be built into Denver in fifteen months. A sixth is expected. The Chicago, Burlington & Quincy will probably begin to build into Denver before many months. The construction contracts for the Denver, Utah & Pacific have been let, and a hundred miles of the road will be built within a year. It will run through Middle Park, and from thence westerly. The Chicago, Burlington & Quincy surveyors are running a line for a road to be built westerly from Denver to the Pacific. Two companies to build Silver Cliff roads have been organized and are at work. The record is certainly a good one.—*Denver Tribune, Jan.* 1.

RIVERS AND HARBORS.

The Portland (Oregon) Board of Trade is about to memoralize Congress for the improvement of the Lower Columbia.

CANALS.

There is considerable change of sentiment among Baltimore people with regard to the different routes proposed for the Delaware & Maryland Canal. The whole peninsula has been surveyed by Major Hutton, under the direction of Col. Wm. P. Craighill, of the U. S. Engineer Corps. The line by the Choptank River meets with most favor, and the different Boards of Trade have adopted it. The Sassafras Company is a private undertaking, and the boards are in favor of the government undertaking the work.

NEW PROJECTS.

Mayor Overstolz, of St. Louis, has recommended an enlargement of the City Hall in that place.

The Lehigh & Lackawanna Railroad will probably extend its lines in Northampton County, Pa., this season.

Ground has been broken for the Nevada & Oregon Railroad in Evansville, Oregon. Col. Moore is the contractor.

A movement is on foot to build a narrow-gauge railroad from Bonne Terre, St. Francois County, to some point on the Mississippi River.

A corps of surveyors, with eleven men, of the Wabash, St. Louis & Pacific Railway, surveying a route from Kankakee to Kansas City, reached El Paso, Ill., on the 2d inst.

A few days ago the Missouri Valley Transportation Company was organized in Kansas City for the purpose of putting in operation a barge line between that point and St. Louis. It is proposed to put on two tow-boats and 12 barges, and the principal attention of the company will be given to the transportation of grain.

A patent has been taken out at the Interior Department for the Sangre de Christo grant in New Mexico, comprising nearly 1,000,000 acres, but delivery is withheld until the grant owners shall have deposited $3,000 to pay for the survey. This enormous grant is understood to be now owned principally by the Denver & Rio Grande Railroad Company.

The Indianapolis Coal and Southern Railroad has been organized in Indianapolis with the following directors: E. B. Martindale, A. H. Brown, A. L. Wright, F. Baggs, H. R. Allen, T. A. Lewis, Hervey Bates, Wm. Wallace, T. H. Sharpe, Ingram Fletcher, N. S. Byram, J. W. Murphy and T. A. Morris. The road is to be built to Evansville and then on to Memphis.

Two important new schemes are proposed which will materially affect the railway interests in Indiana, to wit: The extension of the Lake Erie & Western to St. Louis, and the Indianapolis, Bloomington & Western to Columbus, O. Surveying parties for both these extensions are already in the field, and for each the speedy construction is claimed as certain.

The new Ocean Shore Railroad will extend from Fulton and Devisadero streets, San Francisco, to the Ocean Beach and follow it to Spanishtown. The projector is R. Turner of New York. Col. Lyman Bridges has arrived from New York to assume control of the work. Operations were to begin Jan. 1. Length of road, 60 miles. One year is given for completion.

A preparatory expedition, composed of engineers and skilled mechanics, left Havre for Panama on the 5th, a Paris dispatch says, to begin a survey and operations immediately. A large number of mechanics and laborers, a quantity of machinery and a large supply of provisions have been ordered in New York and New Orleans for immediate shipment to the scene of operations.

Charles H. Tompkins, Dep't Q. M. G., U. S. A., at St. Paul, Minn., advertises for proposals, to be opened on the 29th inst., for furnishing all labor and material—including machinery—required in the construction and completion, on the Fort Snelling Military Reservation, of a system of water-works for supplying department headquarters with water, in accordance with plans and specifications on file in office of chief quartermaster at Chicago, Ill., and in this office.

The Board of Commissioners of Cook County, Ill., will receive proposals up to 12 o'clock noon, on Monday, Jan. 17, 1881, at the office of the clerk of the board, Criminal Court building, Michigan street, Chicago, Ill., for the office and court-room furniture and fixtures of the several departments of the new Cook County Court-house, in accordance with the plans and specifications of the same, now on file at the office of James J. Egan, architect, room 20 Hawley building, Chicago.

The old pipe foundry of H. R. Smith & Co., of Columbus, Ohio, which has been idle for two years, has been purchased for $65,000, a company to be called the Hocking Valley Pipe Company has been formed, and the work of manufacturing pipe and doing a general foundry business will be resumed as soon as the shops can be put in readiness. Mr. Charles Parrott is president of the company, and will look after the finances, while Messrs. Emmick and Ogden will attend to the mechanical department.

Gen. Dodge, President of the Texas & Pacific, and Chief Engineer Washburn passed through Dallas lately, on their way to Shreveport. Operations will be immediately begun on the New Orleans Pacific. All the grading is done with the exception of about 75 miles. Track laying from both ends will begin by Jan. 1. With regard to the Southeast extension of the Missouri, Kansas & Texas from Greenville to Mineola, now in course of location, he says "Track laying will begin within thirty days, and trains will run to Mineola by May 1."

THE MARKET.

OFFICE OF ENGINEERING NEWS,
Friday Morning, Jan. 7, 1881.

IRON RAILS.—No important change has occurred in this market since our last report. We quote $46@$49.

STEEL RAILS.—Sales are reported of 8,000 tons of Steel Rails at $57.50 at mill, and 1,000 tons of English Steel Rails at $61 per shipment to New York. We quote $57.50@62.50.

OLD RAILS.—During the past week sales have been reported of 5,000 tons of Double Heads at $28@29.25, also 3,000 tons of Tees at $26.50@$27, and 800 tons Old Bridge rails at $28. Prices remain as follows: Double Heads $28, and Tees $26.50.

It has been estimated that the consumption of rails in the United States during 1881 will amount to 1,585,000 tons, new roads taking 935,000, and old roads 650,000, the total mileage being 7,500.

PIG-IRON.—The market for American Pig is quiet, though the tone is good, and there seems to be considerable inquiry. Sales of small quantities are reported at the following figures: No. 1 X Foundry at $25; 2 X, at $22, and Gray Forge at $20. The quotations seem firm as follows: Foundry No. 1, $25; Foundry No. 2 X, $21@$22; Gray Forge, $20@$21.

SCOTCH PIG.—Sales have been exceptionally small during the past ten days, caused largely by the inclemency of the weather, and the almost impassable condition of the streets rendering transportation next to impossible. We quote Eglinton $21.50; Carnbroe, $22; Coltness, $23.50@$24; Glengarnock, $22.50@$23; and Gartsherrie, $22.50@$23.25.

STEEL.—The market is quiet and prices unsettled. We quote as follows:

American Tool, ℔	12	@	13
American Machine	6¾	@	7
American Bessemer	6	@	6¼
Bessemer Tires	5	@	....
English Tool	14½	@	15½

Iron estimates the production of Bessemer and open-hearth steel in England for the past year as follows: Sheffield, 400,000; South Wales, 300,000; Lancashire and Cumberland, 400,000; Cleveland, 200,000; total, 1,300,000; and open-hearth steel, 250,000, making a combined total of 1,550,000 tons.

MANUFACTURED IRON.—Advices from Pittsburgh state that this market is quiet, with a good outlook for spring trade. We quote: Bars, 2.25c.; Sheet Iron, No. 4, 3.75c.; Skelp, 2.25@2.35c.; Plate and Tank, 2.90@3c.; Hoop, 3c.@3.20c.

SHEET-IRON.—Business in this branch is dull, prices being largely nominal; no change is anticipated for some time.

Russia per pound	12	@	12¼
American common singles	3¾	@	4
American common doubles	4¼	@	4½
American refined	5½	@	5¾
Galvanized, Nos. 14 to 20	7½	@	....
Nos. 21 to 24	8½	@	....
Nos. 25 to 26	9½	@	10
Nos. 27 to 28	10½	@	11¼

WROUGHT-IRON.—The demand has not strengthened during the past two weeks, but most of the mills are reported as busily engaged upon unfinished orders. No change in prices, 65@67½ per cent. discount. Boiler Tubes, 40 per cent. off. Oil-Well Casing and Tubing, 21c. and 70c. per foot, net.

CEMENT.—The tone of the market remains firm, with a good and quietly increasing demand for Rosendale and American Portland. We quote:

Rosendale	℔ bbl	$1.15	@	1.25
Portland, Saylor's American		2.25	@	2.50
Portland (English)		2.65	@	3.40
Portland Lafarge		3.20	@	3.00
Portland K. B. & S.		2.90	@	3.00
Portland Burham		2.65	@	....
Lime of Teil		2.20	@	2.30
Lime of Teil	℔ ton	15.00	@	18.00
Roman	℔ bbl	2.75	@	3.25
Keene & Martin's Coarse		6.00	@	6.50
Keene & Martin's Fine		10.50	@	....

LIME.—The demand is good, supplies being taken as soon as received; prices remain unchanged as follows:

Rockland common	$0.90	@	....
Rockland finishing	1.00	@	....
State, common, cargo rate ℔ bbl	.90	@	....
State finishing	1.15	@	....
Ground	.85	@	1.00

Add 25c. to above figures for yard rates.

BRICK.—The following are the current cargo prices for brick.

Pale, per M	$3.50	@	....
Haverstraw Bay, 2ds	7.50	@	7.75
Haverstraw Bay, 1sts	8.00	@	....
Favorite brands	8.25	@	....
Hollow fire clay brick	9.00	@	9.25
Fronts—			
Croton and Croton Points, ℔ M	$10.50	@	$11.00
Philadelphia	....	@	....
Trenton	21.00	@	22.00
Baltimore	30.00	@	....

Yard prices 50c. per M. higher, or, with delivery added, $2 per M. for Hard and $3 per M. for Front Brick. For delivery add $5 on Philadelphia and Trenton and $6 on Baltimore.